MODEL 302di
Field Mounted Rate/Totalizer

USER'S MANUAL

HP-295
November 2002

HOFFER FLOW CONTROLS, INC.
The Turbine Flowmeter Company

107 Kitty Hawk Lane, P.O. Box 2145, Elizabeth City, NC 27906-2145
800-628-4584 252-331-1997 FAX 252-331-2886
www.hofferflow.com E-mail: info@hofferflow.com

NOTICE

Hoffer Flow Controls, Inc. makes no warranty of any kind with regard to this material, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

This manual has been provided as an aid in installing, connecting, calibrating, operating, and servicing this unit. Every precaution for accuracy has been taken in the preparation of this manual; however, Hoffer Flow Controls, Inc. neither assumes responsibility for any omissions or errors that may appear nor assumes liability for any damages that result from the use of the products in accordance with information contained in the manual.

HOFFER FLOW CONTROLS' policy is to provide a user manual for each item supplied. Therefore, all applicable user manuals should be examined before attempting to install or otherwise connect a number of related subsystems. During installation, care must be taken to select the correct interconnecting wiring drawing. The choice of an incorrect connection drawing may result in damage to the system and/or one of the components.

Please review the complete model number of each item to be connected and locate the appropriate manual(s) and/or drawing(s). Identify all model numbers exactly before making any connections. A number of options and accessories may be added to the main instrument, which are not shown on the basic user wiring. Consult the appropriate option or accessory user manual before connecting it to the system. In many cases, a system wiring drawing is available and may be requested from Hoffer Flow Controls.

This document contains proprietary information, which is protected by copyright. All rights are reserved. No part of this document may be photocopied, reproduced, or translated to another language without the prior written consent of Hoffer Flow Controls, Inc.

HOFFER FLOW CONTROLS' policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering. The information contained in this document is subject to change without notice.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. HFC SHALL NOT BE LIABLE FOR ANY LOSS OR DAMAGE RESULTING, DIRECTLY OR INDIRECTLY, FROM THE USE OR LOSS OF USE OF THE GOODS. WITHOUT LIMITING THE GENERALITY OF THE FOREGOING, THIS EXCLUSION FROM LIABILITY EMBRACES THE PURCHASER'S EXPENSES FOR DOWNTIME OR FOR MAKING UP DOWNTIME, DAMAGES FOR WHICH THE PURCHASER MAY BE LIABLE TO OTHER PERSONS, DAMAGES TO PROPERTY, AND INJURY TO OR DEATH OF ANY PERSONS. HFC NEITHER ASSUMES NOR AUTHORIZES ANY PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OR USE OF HFC'S GOODS, AND THERE ARE NO ORAL AGREEMENTS OR WARRANTIES COLLATERAL TO OR AFFECTING THE AGREEMENT. *PURCHASER'S SOLE AND EXCLUSIVE REMEDY IS THE REPAIR AND/OR REPLACEMENT OF NONCONFORMING GOODS AS PROVIDED IN THE PRECEDING PARAGRAPHS. HFC SHALL NOT BE LIABLE FOR ANY OTHER DAMAGES WHATSOEVER INCLUDING INDIRECT, INCIDENTAL, OR CONSEQUENTIALDAMAGES.*

Limited Warranty POLICY FOR Hoffer Flow Controls

HOFFER FLOW CONTROLS, INC. ("HFC") warrants HFC's Precision Series and API Series of turbine flowmeters to be free from defects in material and workmanship under normal use and service, only if such goods have been properly selected for the service intended, properly installed and properly operated and maintained as described in the turbine flowmeter manual. Reference "turbine flowmeter manual" for specific details. This warranty shall extend for a period of five (5) years from the date of shipment to the original purchaser and covers the Precision Series and API Series of flowmeters All other HFC products carry a one (1) year warranty. This warranty is extended only to the original purchaser ("Purchaser"). *Purchaser's sole and exclusive remedy is the repair and/or replacement of nonconforming goods as provided in the following paragraphs.*

In the event Purchaser believes the Hoffer product is defective, the product must be returned to HFC, transportation prepaid by Purchaser, within the appropriate warranty period relative to the product. If HFC's inspection determines that the workmanship or materials are defective and the required maintenance has been performed and, has been properly installed and operated, the product will be either repaired or replaced, at HFC's sole determination, free of additional charge, and the goods will be returned, transportation paid by HFC, using a transportation method selected by HFC.

Prior to returning the product to HFC, Purchaser must obtain a Returned Material Authorization (RMA) Number from HFC's Customer Service Department within 30 days after discovery of a purported breach of warranty, but not later than the warranty period; otherwise, such claims shall be deemed waived. See the Return Requests/inquiries Section of this manual.

If HFC's inspection reveals the Hoffer product to be free of defects in material and workmanship or such inspection reveals the goods were improperly used, improperly installed, and/or improperly selected for service intended, HFC will notify the purchaser in writing and will deliver the goods back to Purchaser upon receipt of Purchaser's written instructions and agreement to pay the cost of transportation. If Purchaser does not respond within thirty (30) days after notice from HFC, the goods will be disposed of in HFC's discretion.

HFC does not warrant the product to meet the requirements of any safety code of any state, municipality, or other jurisdiction, and Purchaser assumes all risk and liability whatsoever resulting from the use thereof, whether used singlely or in combination with other machines or apparatus.

This warranty shall not apply to any HFC product or parts thereof, which have been repaired outside HFC's factory or altered in any way, or have been subject to misuse, negligence, or accident, or have not been operated in accordance with HFC's printed instructions or have been operated under conditions more severe than, or otherwise exceeding, those set forth in the specifications.

FOR **NON-WARRANTY** REPAIRS OR **CALIBRATIONS**, consult HOFFER FLOW CONTROLS for current repair/calibration charges. Have the following information available BEFORE contacting HOFFER FLOW CONTROLS:

1. P.O. number to cover the COST of the repair/calibration,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

CONTENTS

1. Introduction ---------- 1
1-1 Model Number Designation ---------- 2
1-2 Intrinsic Safety Considerations ---------- 4

2. Specifications ---------- 6
2-1 General ---------- 6
2-2 Battery Powered Version ---------- 6
2-3 Loop Powered 4-20mA Output Version ---------- 6
2-4 DC Power/Alarm Version ---------- 7
2-5 Physical ---------- 7

3. Operation ---------- 9
3-1 Display ---------- 9
3-1-1 Front Panel Operation ---------- 9
3-2 Test Mode ---------- 10
3-3 Filtering ---------- 10
3-4 Calculation of Rate and Total ---------- 12
3-5 Total Conversion ---------- 13
3-6 Non-linearity Correction Feature ---------- 14

4. Configuring ---------- 15
4-1 Configuration Steps ---------- 16
4-2 Example ---------- 20

5. Versions ---------- 21
5-1 Battery Powered Version ---------- 21
5-2 4-20mA Output with Alarms Version ---------- 22
5-3 DC POWER VERSION ---------- 24

6. Flowmeter Input ---------- 27

7. Intrinsic Safety Connections ---------- 31
7-1 Coils ---------- 31
7-2 Simple Apparatus ---------- 31
7-3 Alarm Outputs ---------- 33

8. Installation ---------- 35
8-1 Wall Mounting ---------- 35
8-2 Panel Mount Version ---------- 36
8-3 Removing The Front Panel ---------- 37
8-4 The Main Electronics ---------- 39
8-5 Wiring ---------- 40
8-6 Terminal Designations ---------- 40

1. INTRODUCTION

The Model 302*d* Rate-Totalizer is a microprocessor-based instrument which accepts frequency or pulse inputs from a wide range of flowmeters. The instrument displays **Flowrate**, a **Resettable Total**, and an **Accumulated Total** directly in engineering units.

The instrument is compatible with a wide range of flowmeters. Links on the input board enable the circuit to be configured for millivolt signals, reed switches, pulse trains, and most other signal types.

Three different versions of the instrument are available:

1. A Battery Powered version with no outputs
2. A Loop Powered version with 4-20mA output and alarms/pulse output.
3. A DC Powered version with either high and low flow alarms or low flow alarm and pulse output

The Model 302*d* is fully configurable with K-factors, decimal point positions, filter constants, and timebase being programmed via the front panel switches.

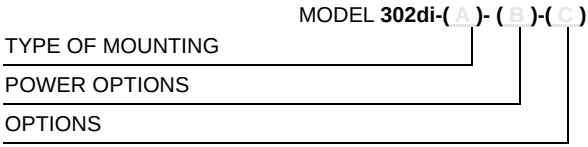
This instrument conforms to the EMC-Directive of the Council of European Communities 89/336/EEC and the following standards:

Generic Emission Standard EN 50081-1	Residential, Commercial & Light Industry Environment.
Generic Emission Standard EN 50081-2	Industrial Environment.
Generic Emission Standard EN 50082-1	Residential, Commercial & Light Industry Environment.
Generic Emission Standard EN 50082-2	Industrial Environment.

In order to comply with these standards, the wiring instructions in Section 8.5 must be followed.

1-1 Model Number Designation

MODEL 302di
DC POWERED RATE/TOTALIZER, INTRINSICALLY SAFE
(TO BE USED ONLY WHEN APPROVALS ARE REQUIRED)



TYPE OF MOUNTING
MODEL **302di-(A)-(B)-(C)**
OPTION (A)

(1) PANEL MOUNT
(2) WALL MOUNT WITH CABLE GLANDS
(3) EXPLOSION-PROOF WITH 1" BOTTOM MOUNT WITH UNION (SEE NOTE 5)
(4) 1" NPT BOTTOM MOUNT WITH UNION (SEE NOTE 5)
(5) 1" NPT REAR MOUNT WITH UNION (SEE NOTE 5)
(6) 2" GALVANIZED PIPE BRACKET (SEE NOTE 6)

POWER OPTIONS
MODEL **302di-(A)-(B)-(C)**
OPTION (B)

(O) LITHIUM BATTERY (INTRINSICALLY SAFE)

(3L) 9-28 VDC POWER WITH LO ALARM, AND HI ALARM OR AN OPEN COLLECTOR OPTO ISOLATED PULSE OUTPUT (USER SELECTABLE). MEMORY BACKUP WITH LITHIUM BATTERY.

(4L) LOOP POWERED WITH LO ALARM, AND HI ALARM OR AN OPEN COLLECTOR OPTO ISOLATED PULSE OUTPUT (USER SELECTABLE). INTRINSICALLY SAFE WITH BARRIER IN SAFE AREA. MEMORY BACKUP WITH LITHIUM BATTERY.

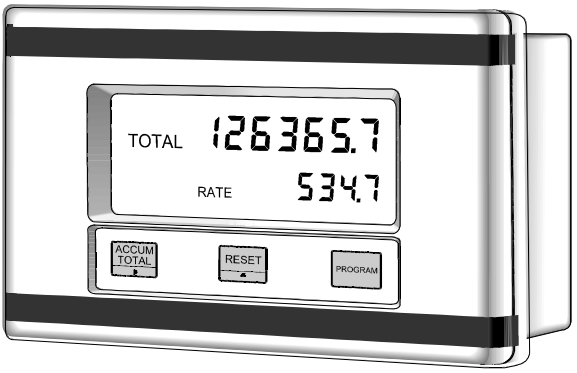
NOTE: SPECIFY DC POWER (OPTION 3) WHEN USING A REDI-PULSE COIL INPUT. BATTERY VERSION IS NOT AVAILABLE FOR USE WITH THE RED-PULSE COIL. LOOP POWERED (OPTION 4L) MAY BE SPECIFIED, HOWEVER,REDI-PULSE COIL MUST HAVE AN ISOLATED DC POWER SUPPLY.

OPTIONS
MODEL **302di-( )-( )-( )**
OPTION
(CE) INTERFERENCE CE COMPLIANCE WITH CSA APPROVAL
(CEN) CENELEC, NRTL/C AND SAA APPROVAL
(CE/CEN) WHEN BOTH APPROVALS REQUIRED
(2) 10 POINT LINEARIZATION

NOTES:

1. MUST USE ISM INTRINSICALLY SAFE MAGNETIC COIL FOR INTRINSICALLY SAFE SYSTEM.
2. STANDARD COILS ARE SUITABLE FOR SYSTEMS THAT DO NOT REQUIRE INTRINSICALLY SAFE.
3. LCD DISPLAY: 7 DIGIT 0.4" (10MM) TOTAL CONTINUOUSLY DISPLAYED
   5 DIGIT 0.33" (85MM) CONTINUOUSLY DISPLAYED RATE, ACCUMULATED DISPLAYED BY KEY DEPRESSION
4. BATTERY LIFE FULL 2 YEARS IF CONTINUOUSLY USED.
5. 1" RISER IS REQUIRED ON TURBINE FOR MOUNTING OPTION (3), (4) OR (5).
6. A GALVANIZED METAL BRACKET ENABLES THE UNIT TO BE ATTACHED TO A 2" VERTICALOR HORIZONTAL PIPE.
7. 10 POINT LINEARIZATION MUST BE CALLED OUT.

APPROVALS
OPTIONAL APPROVALS UNDER (CEN) OPTION
INTRINSICALLY SAFE
WATER TIGHT TO IP67 (NEMA 4X)



The Model 302di

1-2 Intrinsic Safety Considerations

The Model 302*d* is certified for use in hazardous areas and has both CENELEC and CSA C/NRTL approvals.

The Model 302*d* certification details are:

CENELEC Approval:	Kema 98.E.1873.
Type of Protection:	Ex ia.
Group:	IIB.
Temperature Class:	T4 at ambient temperature of 60°C.

CSA C/NRTL Approval	
File Number:	LR 104 840-5.
Type:	Class 1, Groups C and D

When installing in hazardous areas, the instrument must be installed according to the guidelines in Section 6 and in accordance with standards for wiring and installation in hazardous areas.

Flowmeter Inputs

Entity Parameters on the flowmeter input enable connection to a wide range of approved sensors.

Input Parameters are:

Ui = 24V
Ii = 20mA
Pi = 320mW

The internal capacitance and inductance seen on these terminals is 0.002 µF and 0 mH.

Output Parameters are:

Uo = 10.0V
Io = 9.0mA

Maximum allowed external capacitance is 60 µF.
Maximum allowed external inductance is 1.5H.

4-20mA/DC Power

The input can be connected to IS circuits with the following maximum values:

Ui = 28V
Ii = 93mA
Pi = 653mW.

The internal capacitance and inductance seen on these terminals is 0.1 µF and 0 mH.

Relay Outputs

The output can be connected to IS circuits with the following maximum values:

Ui = 28V
Ii = 93mA
Pi = 653mW.

The internal capacitance and inductance seen on these terminals is 0.1 µF and 0 mH.

2. SPECIFICATIONS

2-1 General

Display:	LCD, continuously powered
Resettable Total:	7 digits with 10mm (0.4") high digits. Resettable from front panel.
Accumulated Total:	Displayed when the ACCUM TOTAL button is pressed.
Rate:	4½ digits with 8.5mm (0.33") high digits.
K-factor:	The pulses per unit of measure (e.g. pulses/gallon) is configurable in the range 0.000001 to 999,999.
Decimal Points:	Decimal Point positions are fully configurable for both rate and total.
Timebase:	Rate can be displayed in units per second, minute, hour, or day.
Frequency Range:	0.01Hz to 10kHz.
Signal Type:	Link settable for Sinewave (15mV P-P minimum), Open Collector, Reed Switch, or Pulse.

2-2 Battery Powered Version

Type:	Two lithium battery packs.
Battery Life:	5 years typical.

2-3 Loop Powered 4-20mA Output Version

Scale:	The 4mA and 20mA points are configurable.
Resolution & Linearity:	0.05% of span.
Accuracy:	0.05% of span @ 25ºC. 0.1% (typ) of span, full temperature range.
Update Time:	0.5 seconds.
Connection:	Two wire.
Loop Power Supply:	9-28 volts.
Supply Backup:	Lithium battery.

2-4 DC Power/Alarm Version

Outputs:	Two open collector outputs suitable for driving DC solenoids or external relays. The outputs provide high and low flow alarms or low flow alarm and pulse output.
Switching Power:	200mA 30VDC maximum.
DC Power Input:	9-28 Volt at 4mA maximum.
Supply Backup:	Lithium battery.
Pulse Duration:	1ms if CAL0 = 2 (unscaled pulse output) If CAL0 = 1 (scaled pulse output) automatically adjusts to the output frequency: a. 1ms output > 50Hz b. 10ms output = 5 … 50Hz c. 100ms output < 5Hz

2-5 Physical

Temperature:	Operating: -20°C to 60°C.
Dimensions:	97mm (3.8") high x 150mm (5.9") wide x 41mm (1.6") deep (cable glands not included).
Protection:	Sealed to Nema 4X or IP67 standards.
Cable Entry:	By cable glands.
Wall Mounting:	Universal Mounting Bracket supplied (Standard).
Pipe Mounting:	A galvanized metal bracket is available which enables the Model 302*d* to be attached to a 2" vertical or horizontal pipe.
Turbine Meter Adapter:	An optional mounting stem is available for mounting the Model 302*d* directly on turbine flowmeters which have a 1" MNPT boss.
Panel Mounting:	Supplied with mounting brackets. Terminals accessible from the rear. Not watertight. Cutout: 141mm (5.6”) wide x 87mm (3.4”) high.

3. OPERATION

The Model 302*d* Rate Totalizer accepts a frequency or pulse input from a wide range of flowmeters. The instrument is fully configurable with all operating parameters and calculation constants configurable from the front panel. The setup parameters are stored in a non-volatile memory and are retained for at least 10 years in the event of a power loss.

3-1 Display

The Model 302*d* Rate Totalizer will display:

Rate
Resettable Total
Accumulated Total

Both the Rate and Resettable Total are continuously displayed while the Accumulated Total is only displayed when the ACCUM TOTAL key is pressed. The Resettable Total can be reset at any time by pressing the RESET key.

3-1-1 Front Panel Operation

The keys on the front panel have the following functions:

This key displays the Accumulated Total.

This key resets the Resettable Total at any time.

This key is used during the Program Mode.

3-2 Test Mode

The instrument has a Test Mode which can be entered by simultaneously pressing all three front panel keys. The tests are as follows:

Lo Test By pressing the

key, the low alarm output (if installed) will go low. If a 4-20mA option is installed, the output will go to 4mA.

Hi Test By pressing the

key, and depending on the programmed pulse output mode, the high alarm output (if installed) will:

a. go low if CAL0 = 0 (high alarm output).
b. output 100ms pulses every 0.5 sec if CAL0 = 1 (scaled pulse output).
c. output 1ms pulses every 0.5 sec if CAL0 = 2 (unscaled pulse output).

If a 4-20mA option is installed, the output will go to 20mA.

Display Test By pressing the

key, all segments of the display will flash.

To exit the test mode, all three front panel keys are pressed simultaneously.

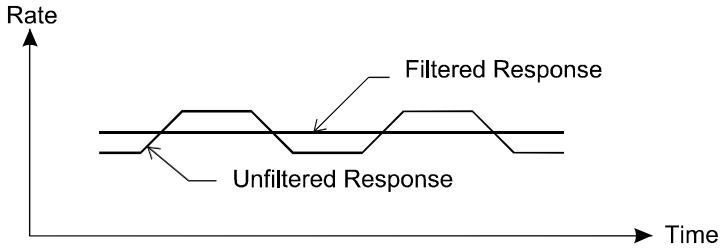
3-3 Filtering

Frequency fluctuations caused by pulsating flow through a flowmeter can interfere with the precision of Rate. For this reason the Model 302*d* Rate Totalizer has a digital filter which will average out these fluctuations and enable accurate readings.

The degree of filtering of the input signal can be adjusted, depending on the amount of fluctuation and the particular application. Values from 1 to 99 can be programmed, where 1 corresponds to no filtering and 99 corresponds to heavy filtering. Such flexibility in filtering means that highly accurate and stable readings can be obtained, while minimizing excessive lag.

When programming the degree of filtering, it is advisable to start with no filtering (the factor equals 1) and gradually increase until a steady reading is obtained. It is important that the filtering is not too heavy because this will cause an overdamped response.

The diagram below shows a pulsating signal input together with the effect of filtering.



As a guideline to the degree of filtering to be used, the following table shows the response to a step change in input. The value, CAL 6, is the filter constant which is entered during the configuration routine. The times for the display value to reach 90% and 99% of full swing are given in seconds, for different values of CAL 6.

A	**90%**	**99%**
1.00	0.00	0.00
2.00	1.00	2.00
4.00	2.00	4.00
6.00	3.00	6.00
10.00	5.00	11.00
15.00	8.00	17.00
20.00	11.00	22.00
25.00	14.00	28.00
35.00	20.00	40.00
45.00	25.00	51.00
60.00	34.00	69.00
75.00	43.00	86.00
90.00	52.00	103.00
99.00	57.00	113.00

Table 1 - Response to a step Input (in seconds).

Note that if CAL 6 is set to 01 there is no filtering of the input signal.

3-4 Calculation of Rate and Total

The flowrate, R, is calculated as follows:

$$R = \frac{fxH}{S}$$

where f is the input frequency in Hz.
H is the timebase of rate and is 1 for seconds, 60 for minutes, 3600 for hours, and 86,400 for days.
S is the Scaling Factor.

The Scaling Factor, S, is equal to the K-factor of the flowmeter expressed in pulses per unit volume.

The user configures the Scaling Factor and selects the timebase during the Configuration procedure.

3-5 Total Conversion

The Total Conversion Factor enables the RATE to be displayed in one engineering unit (e.g. gallons/minute) and the TOTALS to be displayed in another engineering unit (e.g. barrels).

The Total Conversion Factor is a division factor which can be used to convert the totals to the different unit. The Total Conversion factor affects the resettable and accumulated totals.

For Example:

If the Rate is required in gallons per minute:

1. The Scaling Factor would be configured as pulses per gallon
2. The timebase would be configured as minutes

If the Totals are required in barrels:

3. The Total Conversion factor is configured as 42 (there are 42 gallons in a barrel). All totals will now totalize in barrels.

Some common units are given below together with the Total Conversion constant which should be configured.

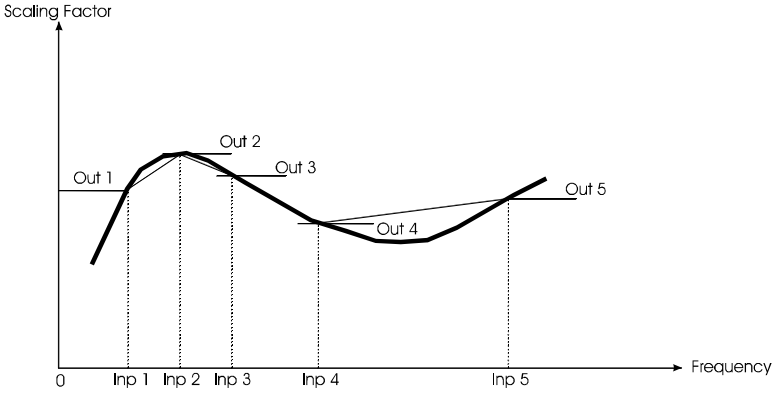
Rate*	Totals	TOTCON
Gallons (US)/	Barrels (oil)	42.000
Litres/	Kilolitres	1000
ml/	Litres	1000
Mgallons/	Acre-feet	0.32587

* Units per second, minute, hour, or day. The timebase is configured separately during Configuration.

3-6 Non-linearity Correction Feature

This optional feature allows the instrument to be used with non-linear flowmeters providing up to 10 non-linearity corrections points.

The following diagram graphs the change in scaling factor with frequency for a hypothetical flowmeter. The heavy line represents the actual scaling factor of the flowmeter, while the light line is the approximation used in the instrument.



Up to 10 frequencies and scaling factors may be configured. Frequencies must be entered in ascending order. Linear Interpolation is used between points. If the input frequency is below the first or above the last frequency, the scaling factor will maintain a constant value.

Note: Display update time increases to 1 second if the non-linearity correction feature is used with the battery powered version of this instrument.

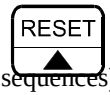
4. CONFIGURING

The Model 302*d* is fully configurable, with all parameters being stored in non-volatile memory.

The Program Mode can be entered in one of two ways:

1. By removing the lower cover strip (i.e., the dark gray strip along the bottom of the enclosure), flipping it end-for-end and replacing it on the enclosure. This brings a small magnet on the inside of the cover strip in contact with a reed switch inside the instrument. The PROGRAM key is then pressed to enter the Configuration Mode.
2. By removing the front section of the enclosure which contains the main processor board and batteries. Once removed, the PROGRAM key is pressed to enter the Configuration Mode.

The key is used to step through the program (CAL



sequences) and the

and keys on the front panel are used to change and increment the flashing digits. Note that only flashing digits may be changed.

Up to nineteen CAL steps are accessible, depending on which options are installed. The CAL number is displayed on the lower display and the parameter is displayed on the upper display.

4-1 Configuration Steps

Step ***Comment***

CAL 0 **Pulse Output** (applies to DC Power/Alarm version only)

0 = No pulse output, low and high alarms
1 = Scaled pulse output and low alarm
2 = Unscaled pulse output and low alarm

CAL 1 **Scaling Factor** - whole number
CAL 2 **Scaling Factor** - numbers after the decimal point

The Scaling Factor is the pulses per unit of measure (e.g. pulses/litre, pulses/gallon, etc). The Scaling Factor can be programmed in the range of 0.000001 - 999,999.

CAL 3 **Cutoff Frequency**

This determines the **Cutoff Frequency** in the range of 0.01 - 0.99Hz. the default setting is 0.25 Hz.

NOTE: Care must be taken when setting this value as a low value may cause a slow update time.

CAL 4 **Decimal Point for Rate Display**

The flowrate can be displayed with 0, 1, 2, or 3 decimal places (e.g., 2.000).

CAL 5 **Timebase for Rate**

The **Rate** can be displayed in units per second, minute, hour, or day.

0 = second
1 = minute
2 = hour
3 = day.

Step	*Comment*
CAL 6	**Filter** The **filter constant** for filtering the input signal. **1** No filtering to **99** Very heavy filtering.
CAL 7	**Decimal Point for Total Display** The totals can be displayed with 0, 1, 2, or 3 decimal places (e.g., 2.000).
CAL 8	**Total Conversion Factor** - whole number
CAL 9	**Total Conversion Factor** - numbers after the decimal point The Total Conversion Factor enables the Rate to be displayed in one engineering unit and the Totals to be displayed in another engineering unit. The Total Conversion Factor can be programmed in the range of 0.000001 - 999,999. Set to 1.000 if totals and rate are in the same unit e.g. litres.
NOTE:	CAL 10 thru CAL 13 are displayed regardless of whether the high and low alarms are installed. If the high and low alarms are not installed, these parameters can be ignored.
CAL 10	**Low Alarm -** whole number
CAL 11	**Low Alarm -** numbers after the decimal point CAL 10 & 11 program the flowrate below which the low alarm relay will close. The value can be programmed in the range 0 to 999,999.

Step	*Comment*
CAL 12	**High Alarm/Pulse Output Factor -** whole number
CAL 13	**High Alarm/Pulse Output Factor -** numbers after the decimal point
	CAL 12 & 13 program the flowrate above which the high alarm relay will close. The value can be programmed in the range 0 to 999,999. If the scaled pulse output is selected (CAL0 = 2) then the value represents the total per pulse (e.g., 5 gallons per pulse).
NOTE:	CAL 14 thru CAL 17 are displayed regardless of whether the 4-20mA re-transmission is installed. If the 4-20mA re-transmission is not installed, these parameters can be ignored.
CAL 14	**4mA Re-transmission -** whole number
CAL 15	**4mA Re-transmission -** numbers after the decimal point
	CAL 14 & CAL 15 represent the flowrate at which 4mA will be output.
CAL 16	**20mA Re-transmission -** whole number
CAL 17	**20mA Re-transmission -** numbers after the decimal point
	CAL 16 & 17 represent the flowrate at which 20mA will be output.
NOTE:	CAL 18 and INP##/OUT## fields are displayed only when the optional Non-Linearity Correction Feature is installed.
CAL 18	**Number of non-linearity correction points.**
	00 = Non-linearity correction disabled xx = Non-linearity correction enabled; 'xx' points to enter. Maximum 10 points.

Step	*Comment*
NOTE:	The number of INP & OUT fields displayed will equal the number of correction points entered in CAL 18.
INP ##	**Input Freq Point ## -** whole number
INP ##	**Input Freq Point ## -** numbers after the decimal point Input points must be entered in ascending order.
OUT ##	**Output Scaling Factor Point ## -** whole number
OUT ##	**Output Scaling Factor Point ## -** numbers after the decimal point Output points must NOT be set to zero.
SOFT	**Software Version**

4-2 Example

A flowmeter produces 20.538 pulses per gallon and has a maximum output frequency of 200Hz. It is required to display the flowrate in gallon/min with 1 digit to the left of the decimal point and the total in gallon with no digits to the left of the decimal. A 4-20mA output is installed and 4mA is to represent 0 gallon/m and 20mA is to represent 500 gallon/m. The instrument is then programmed as follows:

The Calibration Mode is entered by removing the lower cover strip (i.e., the dark gray strip along the bottom of the enclosure) and flip it end-for-end and replacing it back on the enclosure. The following values are then entered:

Step	***Value***	***Description***
CAL00	0	No Pulse Output
CAL01	00020	Scaling Factor (Whole Numbers)
CAL02	5380	Scaling Factor (Decimals)
CAL03	0.25	Cutoff Frequency
CAL04	1	Rate decimal position
CAL05	1	Timebase
CAL06	01	Filter disabled
CAL07	0	Total decimal position
CAL08	0001	Total Conversion (set to 1.0000)
CAL09	0000	Total Conversion (decimals)
CAL10	00000	Low Alarm (not installed)
CAL11	0000	Low Alarm (not installed)
CAL12	00000	High Alarm (not installed)
CAL13	0000	High Alarm (not installed)
CAL14	00000	4mA Output (Whole Numbers)
CAL15	0000	4mA Output (Decimals)
CAL16	00500	20mA Output (Whole Numbers)
CAL17	0000	20mA Output (Decimals)
SOFT	1.01	Software Version
CARD	0	Battery Version input card

5. VERSIONS

5-1 Battery Powered Version

The battery powered version of the Model 302*d* is designed for operation in the field without external power sources. Lithium batteries provide sufficient power to operate the instrument for up to 5 years and the operator is warned of a low power condition by a message on the LCD display.

New batteries can be purchased from Hoffer Flow Controls, Inc. and can be replaced in the field without compromising the IS approvals. *There are two battery packs in each instrument and care must be taken to replace only one pack at a time so that there is always power connected to the memory.* Failure to do this may result in the loss of setup parameters and totals.

5-2 4-20mA Output with Alarms Version

this version combines the features of the DC powered with a 4-20mA output.

The 4-20mA output provides a two wire re-transmission of the flowrate. Both the 4mA and 20mA points are fully configurable so that the output can span across the entire operating range or, alternatively, across a small section of the operating range.

The instrument draws its operating power from the 4-20mA loop and lithium batteries for backup if the 4-20mA loop is interrupted. The alarm/pulse outputs are NOT supported if the 4-20mA loop is interrupted.

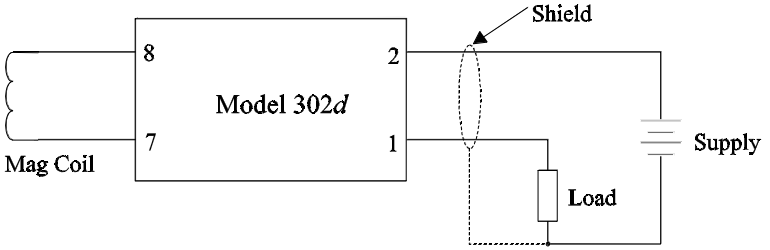
Specification

Resolution & Linearity:	0.05% of span.
Accuracy:	0.05% of span at 25ºC. 0.1% (typ) of span full temperature range.
Response (4mA to 20mA):	0.5 Seconds.
Loop Power Supply:	9-28 VDC.

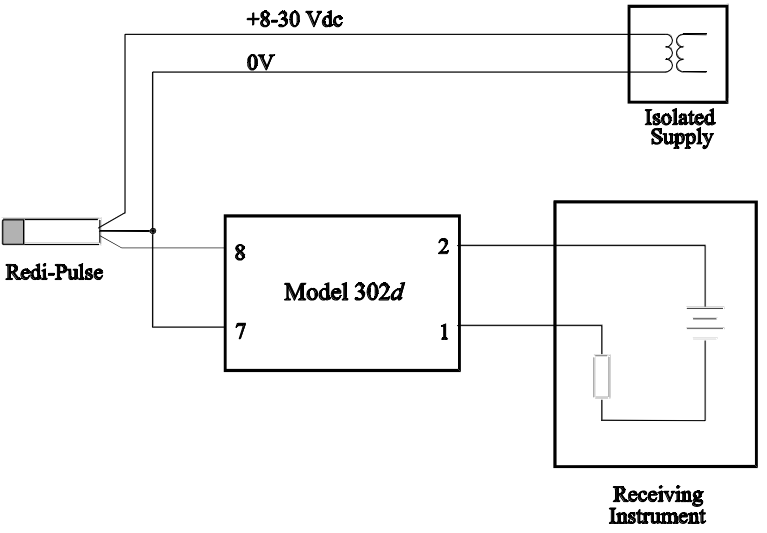
Important

Since the 4-20mA output is designed to provide power to the Model 302*d*, it is not isolated from the input. Hence, all sensors *must* be self-powering (such as MAG coils & reed switches). If external power is required to power the sensor (e.g. Redi-Pulse pick-ups, Hall Effect sensors, or opto-sensors), the power supply delivering the external power must be isolated from the 4-20mA loop supply.

Typical Connection



Connection to a Sensor requiring External Power



5-3 DC Power Version

The DC Power version operates from an external power source between 9-28VDC and draws no more than 4mA. This enables the instrument to be powered from AC adapters and eliminates the need to run AC voltages in the field.

The instrument uses lithium batteries for backup if the DC power is interrupted. *However, alarms and/or pulse outputs are NOT supported if the DC power is interrupted.*

Open collector outputs are also provided for high and low flowrate alarms. If a pulse output is programmed, terminals 5 & 6 act as a pulse out. The outputs can sink up to 200mA and can be used to control external relays, lights, or audible alarms. The outputs are internally protected against voltage spikes which can be caused by relays and coils.

Both outputs are separately isolated via opto isolators.

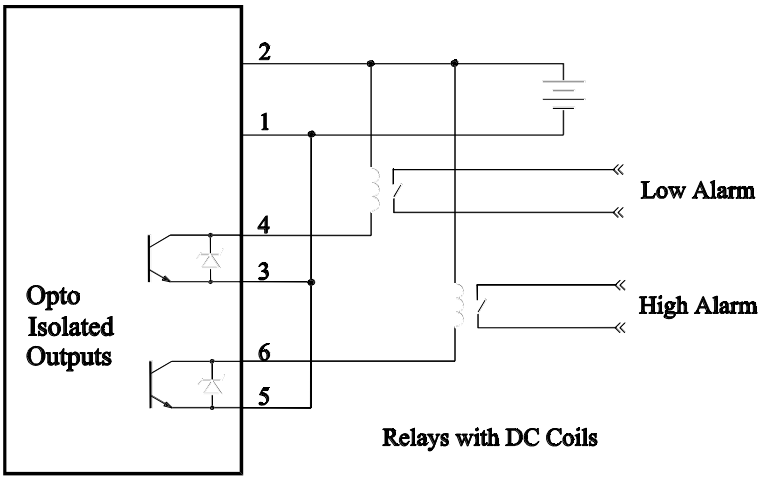
The switching points can be programmed during the setup mode and the low flow alarm will switch on whenever the flowrate drops below the programmed flowrate. Similarly, the high alarm switches on whenever the flow exceeds the high setpoint.

If a Scaled Pulse Output is programmed, a pulse will be output every preset value of total. For example, if the total is in gallons, then programming 5 will output one pulse every 5 gallons. If an Unscaled Pulse Output is programmed, output pulses will follow the input frequency from the flowmeter.

Specification for Alarm Outputs

Maximum Current (sink):	200mA
Maximum Voltage:	30VDC.
Saturation Voltage:	0.8VDC across outputs when in the "ON" state.
Isolation:	Both outputs are separately isolated.
Pulse Frequency:	500Hz maximum.
Pulse Duration:	1ms if CAL0 = 2 (unscaled pulse output) If CAL0 = 1 (scaled pulse output) the duration automatically adjusts to the output frequency: a. 1ms for output > 50Hz b. 10ms for output = 5…50Hz c. 100ms for output < 5Hz

Connections



6. FLOWMETER INPUT

The Model 302*d* has an input conditioning circuit which will accept signals from most pulse or frequency producing flowmeters. Links on the rear panel enables the input circuit to be configured for the different signal types.

The input will interface directly to:

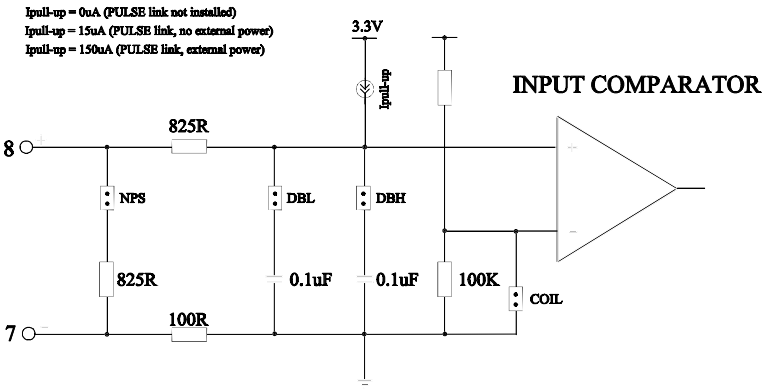
- Turbine Flowmeters
- Open Collector Outputs
- Reed Switches
- Logic Signals
- Two Wire Proximity Switches.

The following pages give examples of interconnection to various signal outputs and a circuit diagram of the input is also provided.

For pulse or logic type signals, the input switching threshold is 1.3 volts. Hence, the input signal must have a "LOW" voltage of less than 1.2 volts and a "HIGH" voltage of greater than 1.4 volts.

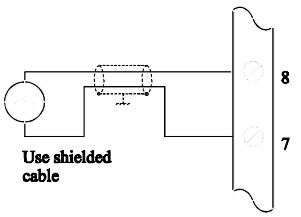
For flowmeters with coils, the minimum input voltage is 15mV P-P.

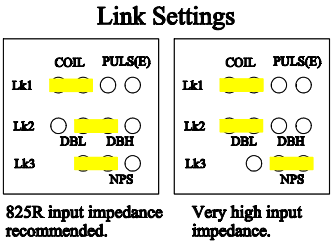
All inputs are protected for over voltage up to 28 volts.



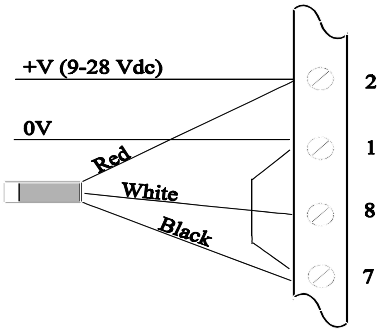
Simplified Frequency Input Circuit

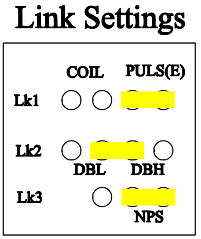
1. MAG Coil





2. Redi-Pulse Pick-up (Pulse output)

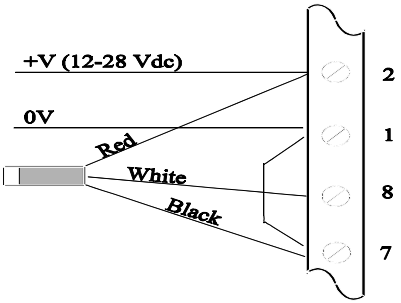


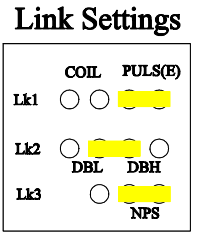


Note: If a 4-20mA output is installed, the supply to the Redi-Pulse must be isolated.

3. Redi-Pulse Pick-up (Open Collector)

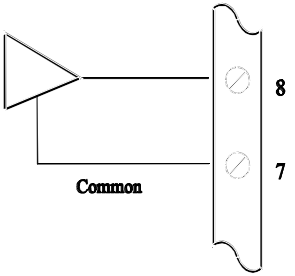
with 15µA internal pullup current

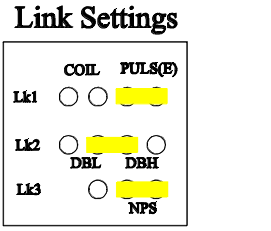




Note: If a 4-20mA output is installed, the supply to the Redi-Pulse must be isolated.

4. Squarewave, CMOS or Pulse

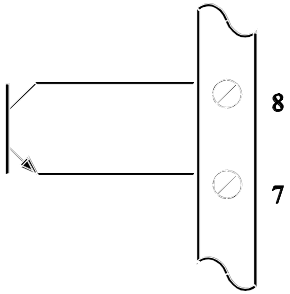


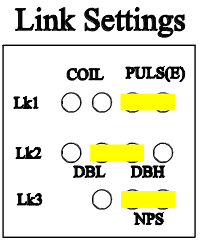


Switching threshold voltage 1.3 voltsl

5. Open Collector

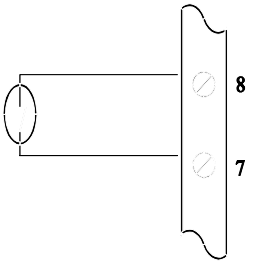
with 15µA/150µA internal pullup current

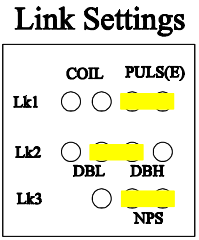




6 Reed Switch - Battery Powered

with 15µA internal pullup current





Note: For a switch or reed input with contact bounce link DBL can be installed. This will eliminate the effect of switch bounce, while limiting the input frequency to 200Hz.

7. INTRINSIC SAFETY CONNECTIONS

When installing the Model 302*d* in hazardous areas, the wiring and installation must comply with appropriate installation standards.

The approval uses entity parameters on the input for connections to the flowmeter and an associated apparatus type approval for the 4-20mA output. The 4-20mA output must, therefore, only be connected as shown on the following page to barriers with the specified parameters.

7-1 Coils

The Model 302*d* will connect directly to a turbine flowmeter with a certified IS coil or other certified IS sensor which produce a pulse output, provided they do not exceed the following input parameters:

Ui = 24V

Ii = 20mA

Pi = 320mW

The maximum allowed capacitance and inductance of the pulser or coil, including cabling is :

Cext = 60µF

Lext = 1.5H

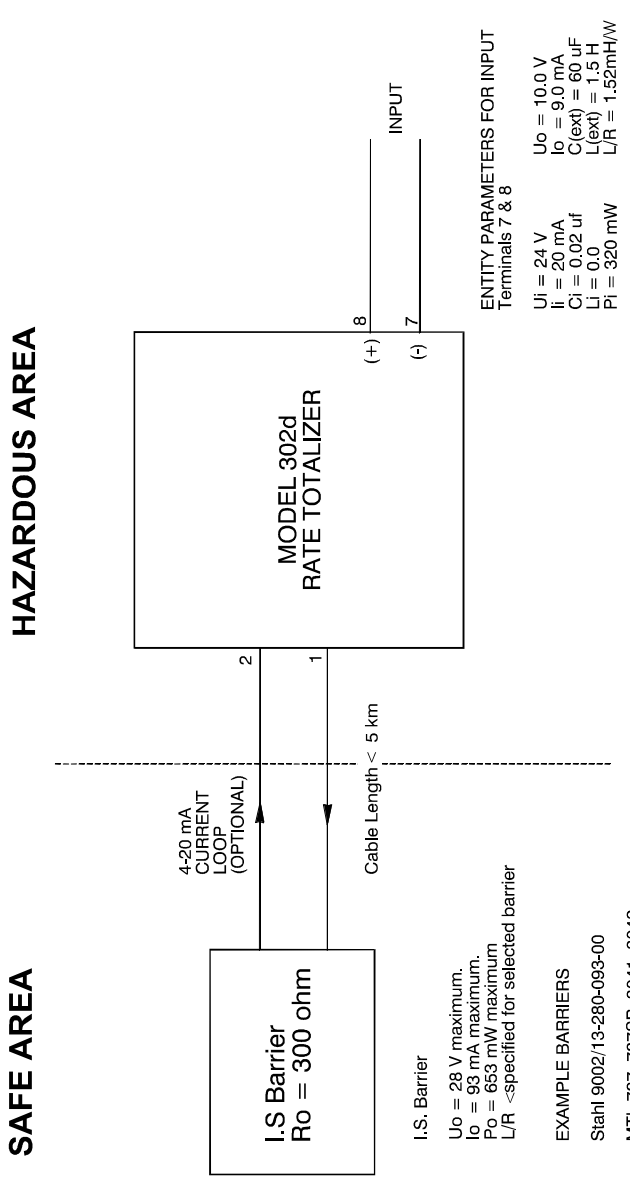
The internal capacitance and inductance of the Model 302*d* seen on the input are negligibly small with Ci = 0.02uF and Li = 0mH. The maximum voltage and current produced on the inputs (terminals 8 & 7) are:

Uo = 10.0 volts (open circuit)

Io = 9.0mA (short circuit)

7-2 Simple Apparatus

Devices such as reed switches, which can be classed as “Simple Apparatus” as defined in the CENELEC standard EN50020, can be connected to the Model 302*d* without certification.


SAFE AREA
HAZARDOUS AREA
I.S Barrier
Ro = 300 ohm
4-20 mA
CURRENT
LOOP
(OPTIONAL)
2
1
Cable Length < 5 km
MODEL 302d
RATE TOTALIZER
8
7
(+)
(-)
INPUT
ENTITY PARAMETERS FOR INPUT
Terminals 7 & 8
Ui = 24 V
Ii = 20 mA
Ci = 0.02 uf
Li = 0.0
Pi = 320 mW
Uo = 10.0 V
Io = 9.0 mA
C(ext) = 60 uF
L(ext) = 1.5 H
L/R = 1.52mH/W
I.S. Barrier
Uo = 28 V maximum.
Io = 93 mA maximum.
Po = 653 mW maximum
L/R <specified for selected barrier
EXAMPLE BARRIERS
Stahl 9002/13-280-093-00
MTL 787, 787SP, 3041, 3042
2441, 2442, 4041, 4045
PEPPERL & FUCHS
Z428/Ex, Z488/Ex, Z488/Ex-R
KHD3-ICR/Ex 130 200
ZG31/Ex
Input Parameters and
4-20mA Retransmission

7-3 Alarm Outputs

The low alarm and high alarm/pulse output can be connected to suitably certified devices providing the circuit is protected with a barrier with the maximum safety parameters:

Uo = 28V

Io = 93mA

Pmax = 653mW

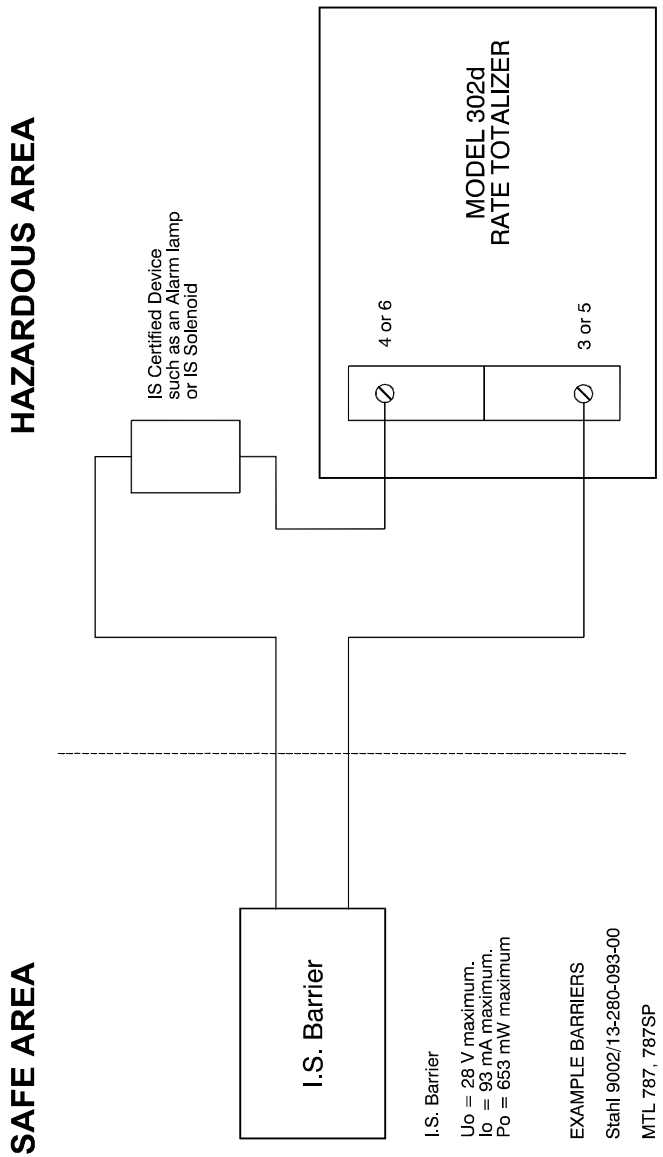
The maximum allowed capacitance and inductance of the pulser or coil, including cabling is :

Cext = 60μF

Lext = 1.5H

The input capacitance on these terminals is 0.1uF max and the inductance is negligible.

Note that the two alarm outputs must be kept as independent IS circuits and each protected with their own barrier. It is not permissible to connect these circuits via a common barrier.

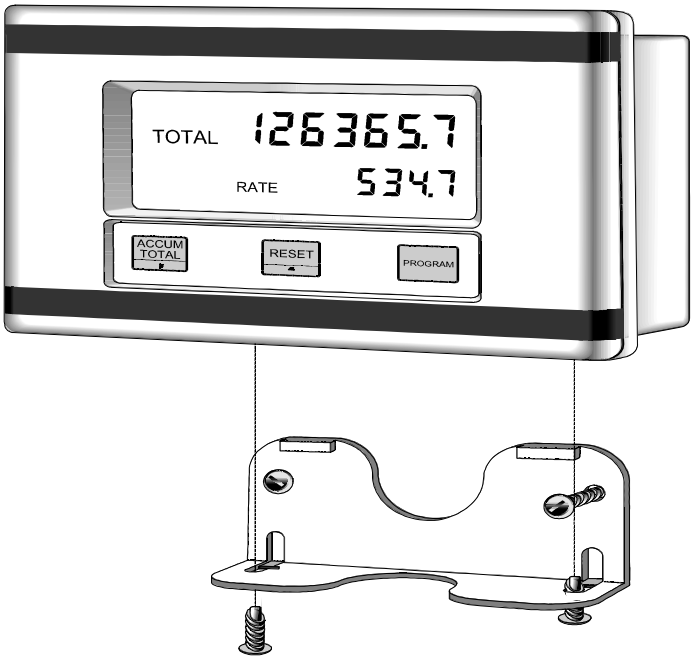


Alarm/Pulse Output Parameters

8. INSTALLATION

8-1 Wall Mounting

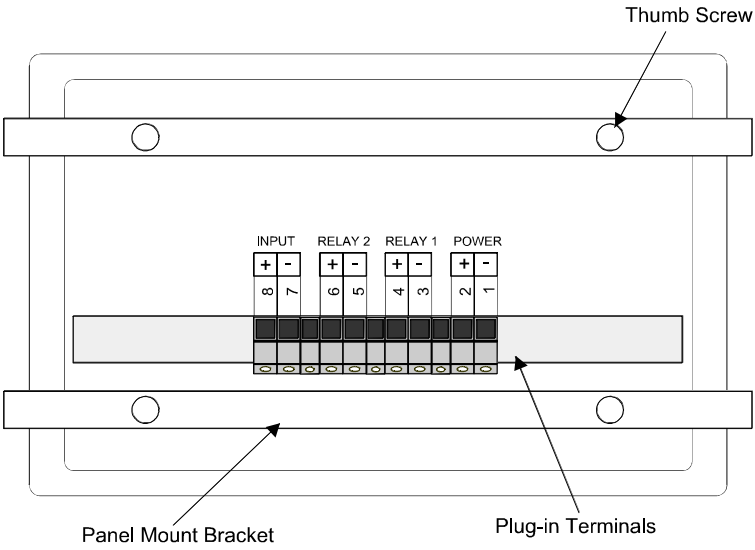
A wall mounting bracket is supplied with each instrument. The bracket should be attached to the wall using round head screws (do not use counter sunk screws). The bracket is mounted with the "tray" section at the bottom. The instrument is then attached to the bracket at the bottom with two screws (see diagram below)



8-2 Panel Mount Version

The panel mount version of the Model 302*d* is supplied with two panel mounting brackets and plug-in terminals which are accessible from the rear of the instrument.

A diagram of the rear panel is shown below:



8-3 Removing The Front Panel

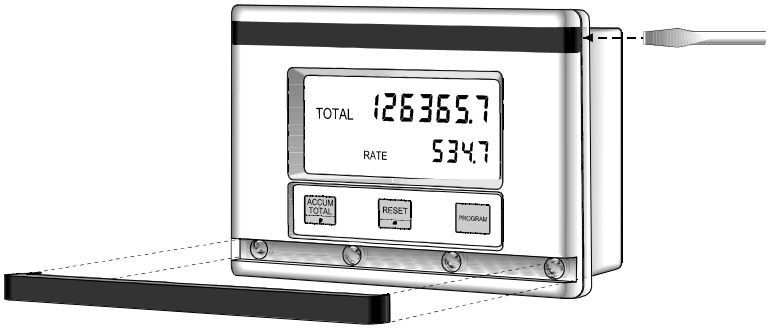
The front of the instrument is removed as follows:

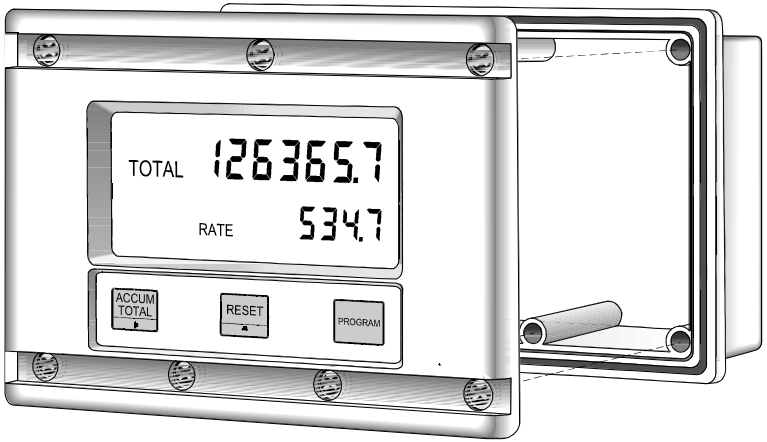
1. Remove both the top and bottom cover strips (i.e. the dark plastic strips on the front) by levering a screwdriver under one end.

2. Undo the seven screws retaining the front. *Note that the screws should not be removed from the front panel as they are retained by O-rings.*

3. Pull the front panel free from the housing.

Replacing the front panel of the instrument is the reverse procedure. However, ensure that the front panel is aligned at both connector points before tightening the screws.


TOTAL
126365.7
RATE
534.7
ACCUM TOTAL
RESET
PROGRAM


TOTAL
126365.7
RATE
534.7
ACCUM TOTAL
RESET
PROGRAM

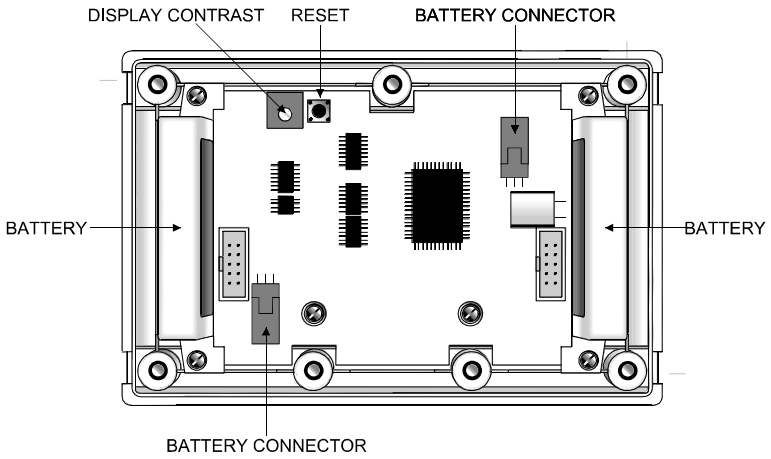
8-4 The Main Electronics

The front section of the housing contains the microprocessor, batteries and display.

When replacing the lithium battery packs, only one battery pack should be replaced at a time so that there is always one pack connected to power the memory.

It is also possible to adjust the display contrast via a small potentiometer on the board. The DISPLAY CONTRAST control is shown below and this can be adjusted for optimum contrast.

Adjacent to this control is a RESET switch which can be used to reset the microprocessor. *Note that pressing this button will reset all Setup Parameters and set all totals to zero*.



The Main Electronics

8-5 Wiring

When connecting the Model 302*d*, it is good practice to use shielded cable. The shield should be connected to earth ground near the instrument. The other end of the shield should not be connected.

In order to comply with the requirements for Electromagnetic Compatibility, as per EMC-Directive 89/336/EEC of the Council of European Community, this wiring practice is mandatory.

8-6 Terminal Designations

All Versions

7	Pulse Input (-)/Coil Input
8	Pulse Input (+)/Coil Input
3	Low Alarm (-)
4	Low Alarm (+)
5	High Alarm/Pulse Output (-)
6	High Alarm/Pulse Output (+)

4-20mA Output

1	4-20mA (-)
2	4-20mA (+)

DC Power Versions

1	DC Power	0V
2	DC Power	+9 to 28 VDC